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Dominion

November 17, 2003

10 CFR 50.54(f)

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
11555 Rockville Pike
Rockville, Maryland 20852

Serial No. 03-459A
B19000
NL&OS/ETS R1
Docket No. 50-338/339
50-423
License No. NPF 4/7
NPF-49

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
DOMINION NUCLEAR CONNECTICUT, INC (DNC)
NORTH ANNA POWER STATION UNITS 1 AND 2
MILLSTONE POWER STATION UNIT 3
NINETY-DAY RESPONSE TO NRC BULLETIN 2003-02
LEAKAGE FROM REACTOR PRESSURE VESSEL LOWER HEAD PENETRATIONS AND REACTOR COOLANT PRESSURE BOUNDARY INTEGRITY

On August 21, 2003 the NRC issued NRC Bulletin 2003-02, "Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity." The bulletin informs licensees that in light of the previous indications of cracking on the upper reactor pressure vessel (RPV) head penetrations in the industry and the recent leakage indications on the two lower RPV head penetrations at South Texas Project Unit 1, the current methods of inspecting the RPV lower heads may need to be supplemented with additional measures (e.g., bare-metal visual inspections) to detect reactor coolant pressure boundary (RCPB) leakage. The bulletin requires licensees to provide a description of the inspection programs previously implemented at their plants that address RPV lower head penetration, as well as a description of the subsequent inspection programs that will be implemented during future refueling outages.

For licensees with upcoming refueling outages scheduled after December 31, 2003, the bulletin requests a response within 90 days of the date of the bulletin. The 90-day responses for North Anna Units 1 and 2 and Millstone Unit 3 are provided herein as Attachments 1 and 2, respectively.

If you have any questions or require additional information, please contact Mr. Thomas Shaub at (804) 273-2763.

Very truly yours,

David A. Christian
Senior Vice President – Nuclear Operations and Chief Nuclear Officer
Virginia Electric and Power Company
Dominion Nuclear Connecticut, Inc

A109

Attachments

1. Ninety-Day Response to NRC Bulletin 2003-02, North Anna Units 1 and 2
2. Ninety-Day Response to NRC Bulletin 2003-02, Millstone Unit 3

Commitments made in this letter:

1. A bare-metal visual examination of the 50 bottom-mounted instrumentation penetration nozzles will be performed during the currently scheduled North Anna Unit 2 Spring 2004 refueling outage and the North Anna Unit 1 Fall 2004 refueling outage as described in Attachment 1.

2. A bare-metal visual examination of the 58 bottom-mounted instrumentation penetration nozzles will be performed during the currently scheduled Millstone Unit 3 Spring 2004 refueling outage as described in Attachment 2.

3. A 360-degree bare-metal visual examination of the bottom-mounted instrumentation penetration nozzles will be performed during subsequent refueling outages for North Anna Units 1 and 2 and Millstone Unit 3. These schedules may be adjusted in the future should ongoing research and inspection results justify a less frequent performance-based sample inspection schedule.

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SN: 03-459A
B19000
Docket Nos.: 50-338/339/423
Subject: 90 Day Response to NRC Bulletin 2003-02

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by David A. Christian who is Senior Vice President and Chief Nuclear Officer of Virginia Electric and Power Company and Dominion Nuclear Connecticut, Inc. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of those companies, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 17th day of November, 2003.

My Commission Expires: March 31, 2004.

Maggie McClure
Notary Public

(SEAL)

ATTACHMENT 1

North Anna Units 1 and 2 Ninety-Day Response to NRC Bulletin 2003-02 Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity

North Anna Power Station Units 1 and 2

Virginia Electric and Power Company
(Dominion)

Ninety-Day Response to NRC Bulletin 2003-02
Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity

North Anna Power Station Units 1 and 2

On August 21, 2003 the NRC issued Bulletin 2003-02, "Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity." The bulletin requires licensees to provide information related to inspections that have been or will be performed to verify the integrity of the reactor pressure vessel (RPV) lower head penetrations. A ninety-day response from the date of the bulletin is required for licensees with refueling outages scheduled after December 31, 2003. As the next North Anna Power Station Units 1 and 2 refueling outages are scheduled in 2004, a ninety-day response to the bulletin is required and is provided below.

Requested Information

(1) All subject PWR addressees are requested to provide the following information. The responses for facilities that will enter refueling outages before December 31, 2003, should be provided within 30 days of the date of this bulletin. All other responses should be provided within 90 days of the date of this bulletin.

(a) A description of the RPV lower head penetration inspection program that has been implemented at your plant. The description should include when the inspections were performed, the extent of the inspections with respect to the areas and penetrations inspected, inspection methods used, the process used to resolve the source of findings of any boric acid deposits, the quality of the documentation of the inspections (e.g., written report, video record, photographs), and the basis for concluding that your plant satisfies applicable regulatory requirements related to the integrity of the RPV lower head penetrations.

Response

Previously Implemented Inspection Program for RPV Lower Head Bottom Mounted Instrumentation (BMI) Penetration Nozzles

Prior to 1992, North Anna Units 1 and 2 performed visual (VT-2) examinations of the bottom of the reactor vessel during the system leakage test and during the system hydrostatic test. These examinations were performed every refueling outage and were conducted in accordance with ASME Code, Section XI, Category B-P, Item Nos. B15.10 and B15.11, which require a visual (VT-2) examination of the bottom of the reactor vessel during the system leakage test of IWB-5221 and during the system hydrostatic test of IWB-5222. Consistent with ASME Code requirements, these examinations were conducted outside the RV lower head insulation. Since the containment building is maintained at subatmospheric conditions during the system leakage test and the system hydrostatic test, the examiner was required to wear a self-contained breathing apparatus

that limited his work duration and mobility. Consequently, Code relief was granted by the NRC in 1992 for both Units 1 and 2 to perform the same VT-2 Code examinations when the reactor containment was at atmospheric conditions and the reactor vessel was at ambient temperature and pressure (References 1 and 2). Therefore, the post-1992 VT-2 exam was also conducted outside the RV lower head insulation in accordance with the conditions specified in the NRC-approved relief request. These examinations have been performed every refueling outage since 1992.

The results of the visual exam are documented in the applicable station procedure and forwarded to company records for maintenance after each refueling outage. No evidence of leakage was identified during the examinations discussed above.

Although not performed by a qualified VT-2 individual, a bare-metal visual inspection was performed for the North Anna Unit 1 RPV lower head BMI penetration nozzles during the Spring 2003 refueling outage. Based on limited accessibility, each of the 50 penetrations was inspected to the extent practicable, with a full 360-degree inspection being conducted on about 35 of the 50 penetrations (70%). No evidence of boric acid leakage at any BMI penetration nozzle was identified during this inspection. Digital photographs of the BMI penetration nozzle area were made to the extent possible for future reference.

Regulatory Requirements

NRC Bulletin 2003-02 notes the following provisions in existing NRC regulations and plant operating licenses that pertain to the reactor coolant pressure boundary:

- Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants"

  Criterion 14 – "Reactor Coolant Pressure Boundary"

  Criterion 31 – "Fracture Prevention of Reactor Coolant Pressure Boundary", and

  Criterion 32 – "Inspection of Reactor Coolant Pressure Boundary"
- Plant Technical Specifications
- 10 CFR 50.55a, Codes and Standards, which incorporates by reference Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components, of the ASME Boiler and Pressure Vessel Code"
- Appendix B of 10 CFR Part 50, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," Criteria V, IX, and XVI

The following discussion addresses each of these criteria.

Design Requirements: 10 CFR § 50, Appendix A – General Design Criteria (GDC)

- Criterion 14 – Reactor Coolant Pressure Boundary

  "The reactor coolant pressure boundary shall be designed, fabricated, erected and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture."

- Criterion 31 – Fracture Prevention of Reactor Coolant Pressure Boundary

  "The reactor coolant pressure boundary shall be designed with sufficient margin to assure that when stressed under operating, maintenance, testing, and postulated accident conditions (1) the boundary behaves in a non-brittle manner, and (2) the probability of rapidly propagating fracture is minimized. The design shall reflect consideration of service temperatures and other conditions of the boundary material under operating, maintenance, testing and postulated accident conditions and the uncertainties in determining (1) material properties, (2) the effects of irradiation on material properties, (3) residual, steady state and transient thermal stresses, and (4) size of flaws."

- Criterion 32 – Inspection of Reactor Coolant Pressure Boundary

  "Components which are part of the reactor coolant pressure boundary shall be designed to permit (1) periodic inspection and testing of important areas and features to assess their structural and leak tight integrity, and (2) an appropriate material surveillance program for the reactor pressure vessel."

During the initial plant licensing of North Anna Power Station Units 1 and 2, it was demonstrated that the design of the reactor coolant pressure boundary met the regulatory requirements in place at that time. The Construction Permits for North Anna Units 1 and 2 were issued prior to May 21, 1971. The GDC included in Appendix A to 10 CFR Part 50 did not become effective until May 21, 1971. Consequently, these units were not subject to GDC requirements. (Reference SECY-92-223 dated September 18, 1992.) However, the following information demonstrates compliance with the design criteria relative to the RPV lower head BMI penetration nozzles:

- Pressurized water reactors licensed both before and after issuance of Appendix A to 10 CFR Part 50 (1971) complied with these criteria in part by: 1) selecting Alloy 600 or other austenitic materials with excellent corrosion resistance and extremely high fracture toughness, for reactor coolant pressure boundary materials, and 2) following ASME Codes and Standards and other applicable requirements for fabrication, erection, and testing of the pressure boundary parts. NRC reviews of operating license submittals subsequent to issuance of Appendix A included evaluating designs for compliance with the General Design Criteria. GDC requirements in effect at the time of North Anna's licensing did not address the selection of Alloy 600. They only required that ASME Code requirements be satisfied.

- Although stress corrosion cracking of primary coolant system penetrations was not originally anticipated during plant design, it has occurred in the RPV top head nozzles at some plants. The root cause of the boric acid accumulation identified at South Texas Project Unit 1 at two BMI locations has yet to be determined. However, the robustness of the design has been demonstrated by the small amounts of the leakage that have occurred on the RPV upper head penetration nozzles and by the fact that none of the cracks in Alloy 600 reactor coolant pressure boundary materials has rapidly propagated or resulted in catastrophic

failure or gross rupture. Given the inherently high fracture toughness and flaw tolerance of the Alloy 600 material, there is in fact an extremely low probability of a rapidly propagating failure and gross rupture. It should be noted that early versions of the applicable GDCs presented design criteria in functional terms of extremely low probability of gross rupture or significant leakage throughout design life.

- The current ASME requirement for the inspection of BMI penetration nozzles is for a visual (VT-2) examination of the bottom of the reactor vessel during the system leakage test of IWB-5221 and/or system pressure test of Code Case N-498-1 (Unit 1 only). Consistent with ASME Code requirements, these examinations are conducted outside the RPV lower head insulation. As noted above, Code relief was granted by the NRC to perform the same VT-2 Code examination when the reactor containment is at atmospheric conditions and the reactor vessel is at ambient temperature and pressure (Reference 1). As noted above, a bare-metal visual inspection was performed for the North Anna Unit 1 RPV lower head BMI penetration nozzles during the Spring 2003 refueling outage. Based on accessibility, each of the 50 penetrations was inspected to the extent practicable, with a full 360-degree inspection conducted on about 35 of 50 penetrations (70%). No evidence of boric acid leakage at any BMI penetration nozzle was identified during this inspection.

As described above, the criteria established for design, fracture toughness, and inspectability in GDC 14, 31, and 32 respectively were satisfied as applicable during initial licensing of the plant and continue to be satisfied during operation. Based on relevant inspections to date, there is no existing plant specific evidence that any of the lower head BMI penetration nozzles at North Anna Unit 1 or 2 is cracked or leaking.

Operating Requirement: 10 CFR 50.36 - Plant Technical Specifications

- 10 CFR 50.36 (2) Limiting Conditions for Operation

  "Limiting conditions for operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met. A technical specification limiting condition for operation of a nuclear reactor must be established for each item meeting one of the following criteria:

  Criterion 3: A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

  Criterion 4: A structure, system or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety."

- 10 CFR 50.36 (3) Surveillance Requirements

  "Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions will be met."

The reactor coolant pressure boundary is one of the three physical barriers to the release of radioactivity to the environment. Therefore, North Anna plant Technical Specifications (TS) include a requirement and associated action statements addressing reactor coolant system boundary leakage. The limits for reactor coolant system leakage at the North Anna units are one gallon per minute for unidentified leakage, ten gpm for identified leakage, and no leakage from the reactor coolant system pressure boundary.

The leakage observed at the two RPV lower head BMI penetration nozzles at South Texas Project Unit 1 were well below the sensitivity of on-line leakage detection systems. A bare-metal visual inspection of the lower head BMI penetration nozzles was conducted during the Spring 2003 North Anna Unit 1 refueling outage. Based on limited accessibility, each of the 50 penetrations was inspected to the extent practicable, with a full 360-degree inspection of about 35 of the 50 penetrations (70%). No indication of leakage was observed. Hypothetically, if a through-wall boundary leak of a BMI penetration nozzle increased to the point that the leakage was identified by an on-line leak detection monitor, then the leakage must be evaluated per the specified TS acceptance criteria. Specifically, the plant would be shut down if the leak exceeded TS limits, or it is determined that the leak is from the reactor coolant system pressure boundary. Plant TS requirements would continue to be met.

Inspection Requirements: 10 CFR 50.55a and ASME Section XI

10 CFR Part 50.55a requires that inservice inspection and testing be performed per the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, "Inservice Inspection of Nuclear Power Plant Components." Section XI contains applicable rules for examination, evaluation and repair of code class components, including the reactor coolant pressure boundary.

As noted above, the current ASME requirements (1989 Edition for Unit 1 and 1995 Edition, 1996 addenda for Unit 2) for BMI penetration nozzles is for a visual (VT-2) examination of the bottom of the reactor vessel during the system leakage test of IWB-5221 and during the system pressure test of Code Case N-498-1 (Unit 1 only). Consistent with ASME Code requirements, these examinations are conducted outside the RPV lower head insulation. Code relief was granted by the NRC to perform the same VT-2 Code examination when the reactor containment is at atmospheric conditions, and the reactor vessel is at ambient temperature and pressure (References 1 and 2).

Furthermore, as noted above, a bare-metal visual inspection was performed for the North Anna Unit 1 RPV lower head BMI penetration nozzles during the Spring 2003 refueling outage. Based on limited accessibility, each of the 50 penetrations was inspected to the extent practicable, with a full 360-degree inspection of about 35 of the 50 penetrations (70%). No evidence of boric acid leakage at any BMI penetration nozzle was identified during this inspection.

The acceptance standard for the visual examination is found in paragraphs IWA-5250, "Corrective Measures," and IWB-3522, "Standards for Examination Category B-E, Pressure Retaining Partial Penetration Welds in Vessels," and "Examination Category B-P, "All Pressure Retaining Components." For Class 1 components, Paragraph IWA-5250 requires repair or replacement of the affected part if a through-wall leak is found and requires an assessment of damage, if any, associated with corrosion of steel components by boric acid. Should repairs to RPV lower head BMI penetration nozzles be required, they will be performed in accordance with Section XI requirements, NRC-approved ASME Code Case requirements, or an alternative repair or replacement method approved by the NRC.

North Anna Units 1 and 2 complies with these ASME Code requirements through implementation of its inservice inspection program.

Quality Assurance Requirements: 10 CFR 50, Appendix B

- Criterion V of Appendix B to 10 CFR Part 50

  Criterion V of Appendix B to 10 CFR Part 50 states that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings. Criterion V further states that instructions, procedures, or drawings shall include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished. Visual examinations of RPV lower head BMI penetration nozzles will be documented in accordance with these requirements. Any of the work undertaken to inspect, evaluate, and/or repair the North Units 1 and 2 RPV lower head BMI penetration nozzles will be conducted and documented in accordance with existing or new procedures which comply with the Company's Quality Assurance (QA) Topical Report, the QA program, and Criterion V of Appendix B to 10 CFR Part 50.

- Criterion IX of Appendix B to 10 CFR Part 50

  Criterion IX of Appendix B to 10 CFR Part 50 states that special processes, including nondestructive testing, shall be controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements.

Furthermore, as noted above, a bare-metal visual inspection was performed for the North Anna Unit 1 RPV lower head BMI penetration nozzles during the Spring 2003 refueling outage. Based on limited accessibility, each of the 50 penetrations was inspected to the extent practicable, with a full 360-degree inspection of about 35 of the 50 penetration (70%). No evidence of boric acid leakage at any BMI penetration nozzle was identified during this inspection.

The acceptance standard for the visual examination is found in paragraphs IWA-5250, "Corrective Measures," and IWB-3522, "Standards for Examination Category B-E, Pressure Retaining Partial Penetration Welds in Vessels," and "Examination Category B-P, "All Pressure Retaining Components." For Class 1 components, Paragraph IWA-5250 requires repair or replacement of the affected part if a through-wall leak is found and requires an assessment of damage, if any, associated with corrosion of steel components by boric acid. Should repairs to RPV lower head BMI penetration nozzles be required, they will be performed in accordance with Section XI requirements, NRC-approved ASME Code Case requirements, or an alternative repair or replacement method approved by the NRC.

North Anna Units 1 and 2 complies with these ASME Code requirements through implementation of its inservice inspection program.

Quality Assurance Requirements: 10 CFR 50, Appendix B

- Criterion V of Appendix B to 10 CFR Part 50

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- Criterion IX of Appendix B to 10 CFR Part 50

  Criterion IX of Appendix B to 10 CFR Part 50 states that special processes, including nondestructive testing, shall be controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements.

Personnel involved with the evaluation of the inspections will be VT-2 qualified in accordance with ASME Code requirements and will be familiar with the anticipated type of indication that leakage would cause. Any repair work that may be required in the event that evidence of leakage is identified at any of the North Anna Units 1 and 2 RPV lower head BMI penetration nozzles will be conducted and documented in accordance with existing or new procedures that will comply with ASME Code, regulatory and Company requirements.

- Criterion XVI of Appendix B to 10 CFR Part 50

Criterion XVI of Appendix B to 10 CFR Part 50 states that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected. For significant conditions adverse to quality, the measures taken shall include cause determination and corrective action to preclude repetition of the adverse conditions. For potential leakage identified at any RPV lower head BMI penetration nozzle, the cause determination is important to understanding the nature of the degradation present and the required actions to mitigate future cracking. Appropriate corrective actions would be initiated to determine the cause of the leakage and the proper repair technique to be used.

Criterion XVI contains two important attributes pertinent to the potential for leakage at any RPV lower head BMI penetration nozzle.

The first of these is "...that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected." This criterion infers a licensee's responsibility to be aware of industry experience, and has been interpreted in this manner in most plants' corrective action programs. A licensee should determine if industry experience applies to its plant and what, if any, corrective actions are appropriate. This approach is consistent with the NRC's generic communication process for an Information Notice, which reports industry experience, but does not require a response to the NRC. Licensees are expected to evaluate the applicability of the occurrence to their plant and document a record of the plant specific assessment for possible NRC review during inspections.

Criterion XVI provides the objectives and goals of the corrective action program, but licensees are responsible for determining a specific process to accomplish these goals and objectives. With regard to the bulletin response, Criterion XVI does not provide specific guidance as to what is an appropriate response, but rather, the licensee is responsible for determining actions necessary to maintain public health and safety. Specifically, in this case, the licensee must justify its actions for addressing the potential of RPV lower head BMI penetration nozzle leakage.

The second attribute of Criterion XVI that should be considered is that for "... significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective action taken to preclude repetition." The bulletin suggests that for potential of RPV lower head BMI

penetration nozzle leakage, the cause determination is important in understanding the nature of the degradation and the required actions to mitigate future leaks. As part of its corrective action program, a licensee, through its own efforts or as part of an industry effort, would determine the cause of the leakage in an RPV lower head BMI penetration nozzle, if leakage were detected. However, if no known leakage in the BMI penetration nozzles was identified through reasonable quality assurance measures or inspection and monitoring programs, this criterion would not require specific action on the part of a licensee for remaining in compliance with the regulation.

In summary, the integrated industry approach to inspection, monitoring, cause determination, and resolution of potential leakage of an RPV lower head BMI penetration nozzle is clearly in compliance with the performance-based objectives of Appendix B. Furthermore as noted above, a bare-metal visual inspection was performed for the North Anna Unit 1 RPV lower head BMI penetration nozzles during the Spring 2003 refueling outage. Based on accessibility, each of the 50 penetrations was inspected to the extent practicable, with a full 360-degree inspection of about 35 of the 50 penetrations (70%). Therefore, Dominion continues to believe that the appropriate regulatory requirements have been met to date.

(b) A description of the RPV lower head penetration inspection program that will be implemented at your plant during the next and subsequent refueling outages. The description should include the extent of the inspections which will be conducted with respect to the areas and penetrations to be inspected, inspection methods to be used, qualification standards for the inspection methods, the process used to resolve the source of findings of boric acid deposits or corrosion, the inspection documentation to be generated, and the basis for concluding that your plant will satisfy applicable regulatory requirements related to the structural and leakage integrity of the RPV lower head penetrations.

Response

A 360-degree bare-metal VT-2 visual examinations of the fifty (50) BMI penetration nozzles underneath the North Anna Units 1 and 2 RPV lower head insulation will be performed during the next North Anna Units 1 and 2 refueling outage currently scheduled for the Fall 2004 and Spring 2004, respectively. These visual examinations of the RPV lower head are considered augmented examinations. Personnel performing this procedure will be qualified as ASME visual level 2 (VT-2) examiners or greater. Each BMI nozzle will be examined for the full 360-degree circumference. Inspection results will be recorded in an inspection report and maintained in station records. High-resolution video recording equipment and/or high-resolution digital still photographs may also be employed to further document the examination, as appropriate. Each BMI nozzle will be examined for the full 360-degree circumference. Inspection results will be recorded in an inspection report and maintained in station records.

As noted in the response to Item 1(a) above, a bare-metal visual inspection was performed for the North Anna Unit 1 RPV lower head BMI penetration nozzles during the

Spring 2003 refueling outage. Based on accessibility, each of the 50 penetrations was inspected to the extent practicable, with a full 360-degree inspection of about 35 of the 50 penetrations (70%). Although the bare metal visual inspection of the BMI penetration nozzles did not cover 360-degrees on each penetration, Dominion anticipates that we will be able to perform a 360-degree visual inspection of the North Anna Units 1 and 2 lower head BMI penetration nozzles during the 2004 refueling outage. However, the presence of boric acid from other sources, or debris, could potentially mask BMI nozzle leakage indications should they exist. In addition, unanticipated interferences or difficulties with insulation removal/modification could inhibit inspection of certain penetration nozzles. Should this occur, any masking boric acid and/or debris will be cleaned off and, if necessary, appropriate modifications would be implemented to ensure that the affected nozzles that could not be adequately assessed during the 2004 outage would be accessible for inspection during the following refueling outage.

Dominion will document the as-found condition of suspect deposits whether adhering to the RPV lower head or present on the insulation facing the RPV. Any such deposit will be carefully evaluated to determine the most likely origin of the material based on visual, physical, and chemical evidence, as appropriate. Visual evidence will be evaluated with consideration of the guidance and examples given in industry reference materials for similar inspections of RPV upper heads supplemented by the recent observed conditions at the South Texas Project. Relevant physical evidence will be collected in a methodical manner that is intended to provide reliable, documented data for use in the evaluation process. Chemical and radioisotopic analysis techniques may be employed where appropriate to help discriminate between indications with operational implications versus indications from outage-related sources. Should evidence of boric acid deposits be identified on any of the BMI penetration nozzles, the finding will be entered into the corrective action program for tracking, cause determination and disposition/resolution of the condition. Appropriate notifications would be made consistent with regulatory requirements.

It is intended that a 360-degree bare-metal visual examination of each RPV lower head BMI penetration nozzle will be performed during each subsequent refueling outage. This schedule may be adjusted in the future should ongoing research and inspection results determine that a less frequent (i.e., performance-based) inspection or sampling schedule is warranted.

Adherence to regulatory requirements was discussed in the response to Item 1(a) above. The performance of a full 360-degree bare-metal visual examination of the RPV lower head BMI penetration nozzles during each subsequent refueling outage as an augmented inspection will further assure adherence to regulatory requirements. This schedule may be adjusted in the future should ongoing research and inspection results justify a less frequent performance-based sample inspection schedule.

(c) If you are unable to perform a bare-metal visual inspection of each penetration during the next refueling outage because of the inability to perform the necessary planning, engineering, procurement of materials, and implementation, are you planning to perform bare-metal visual inspections during subsequent refueling

outages? If so, provide a description of the actions that are planned to enable a bare-metal visual inspection of each penetration during subsequent refueling outages. Also, provide a description of any penetration inspections you plan to perform during the next refueling outage. The description should address the applicable items in paragraph (b).

Response

A full 360-degree bare-metal visual examinations of the 50 BMI penetration nozzles is planned during the next North Anna Units 1 and 2 refueling outages currently scheduled for the Spring and Fall of 2004 for North Anna Unit 2 and 1, respectively. As noted in Dominion's response to Item 1(a) above, a bare-metal inspection of the lower head BMI penetration nozzles was previously performed during the Spring 2003 refueling outage. Although not expected based on previous inspection results, if boric acid from other sources or debris is present, it could potentially mask leakage conditions at the nozzles should they exist. In that case, the masking boric acid and/or debris will be cleaned off the nozzles to allow a full assessment of the affected penetrations during the ongoing outage, if possible. In addition, permanent modification of the lower head RPV insulation is being considered to facilitate easier access to the BMI penetration nozzles during future inspection activities.

(d) If you do not plan to perform either a bare-metal visual inspection or non-visual (e.g., volumetric or surface) examination of the RPV lower head penetrations at the next or subsequent refueling outages, provide the basis for concluding that the inspections performed will assure applicable regulatory requirements are and will continue to be met.

Response

North Anna Units 1 and 2 are planning to perform a 360-degree bare-metal VT-2 visual examinations of the fifty (50) BMI penetration nozzles underneath the Units 1 and 2 RPV lower head insulation during: 1) the next North Anna Units 1 and 2 refueling outage currently scheduled for the Fall 2004 and Spring 2004, respectively and, 2) each subsequent refueling outage. However, this schedule may be adjusted in the future should ongoing research and inspection results determine that a less frequent (i.e., performance-based) inspection or sampling schedule is warranted.

Reference

1. Letter from the USNRC to Mr. William Stewart dated April 7, 1992 (Serial No. 92-255), Safety Evaluation for North Anna Unit 1 Second Interval Inservice Inspection (ISI) Program North Anna Unit 1. (TAC No. M71066).

2. Letter from the USNRC to Mr. William Stewart dated November 5, 1992 (Serial No. 92-730), Safety Evaluation for North Anna Unit 2 Second Interval Inservice Inspection (ISI) Programs. (TAC No. M79147).

ATTACHMENT 2

Millstone Unit 3 Ninety-Day Response to NRC Bulletin 2003-02 Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity

Millstone Power Station Unit 3

Dominion Nuclear Connecticut, Inc.
(DNC)

Ninety-Day Response to NRC Bulletin 2003-02
Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity

Millstone Power Station (MPS) Unit 3

On August 21, 2003 the NRC issued Bulletin 2003-02, "Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity." The bulletin requires licensees to provide information related to inspections that have been or will be performed to verify the integrity of the reactor pressure vessel (RPV) lower head penetrations. A ninety-day response from the date of the bulletin is required for licensees with refueling outages scheduled after December 31, 2003. As the next Millstone Station Unit 3 refueling outages is scheduled in 2004, a ninety-day response to the bulletin is required and is provided below.

Requested Information

(1) All subject PWR addressees are requested to provide the following information. The responses for facilities that will enter refueling outages before December 31, 2003, should be provided within 30 days of the date of this bulletin. All other responses should be provided within 90 days of the date of this bulletin.

(a) A description of the RPV lower head penetration inspection program that has been implemented at your plant. The description should include when the inspections were performed, the extent of the inspections with respect to the areas and penetrations inspected, inspection methods used, the process used to resolve the source of findings of any boric acid deposits, the quality of the documentation of the inspections (e.g., written report, video record, photographs), and the basis for concluding that your plant satisfies applicable regulatory requirements related to the integrity of the RPV lower head penetrations.

Response

Previously Implemented Inspection Program for RPV Lower Head Bottom Mounted Instrumentation (BMI) Penetration Nozzles

Millstone Unit 3 performs visual (VT-2) examinations of the uninsulated bottom of the reactor vessel during the system leakage test that is conducted each refueling outage. This VT-2 examination is required in accordance with the ASME Code, Section XI, Examination Category B-P, and Item No. B15.10, and covers the reactor vessel pressure retaining boundary during the system leakage test of IWB-5221. Additionally, as an alternative to the requirements of Item No. B15.11 the reactor vessel pressure retaining boundary also receives a VT-2 examination during the system leakage test that is conducted at or near the end of each inspection interval in accordance with

ASME Code Case N-498-1 in lieu of the system hydrostatic test of IWB-5222. These VT-2 examinations have been performed every refueling outage.

The results of the visual examinations are documented in the applicable station procedure and forwarded to company records for maintenance after each refueling outage. No evidence of leakage was identified during the examinations discussed above.

Regulatory Requirements

NRC Bulletin 2003-02 notes the following provisions in existing NRC regulations and plant operating licenses that pertain to the reactor coolant pressure boundary:

- Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants"

  Criterion 14 – "Reactor Coolant Pressure Boundary"

  Criterion 31 – "Fracture Prevention of Reactor Coolant Pressure Boundary"

  Criterion 32 – "Inspection of Reactor Coolant Pressure Boundary"
- Plant Technical Specifications
- 10 CFR 50.55a, Codes and Standards, which incorporates by reference Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the ASME Boiler and Pressure Vessel Code
- Appendix B of 10 CFR Part 50, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," Criteria V, IX, and XVI

The following discussion addresses each of these criteria.

Design Requirements: 10 CFR 50, Appendix A – General Design Criteria

- Criterion 14 – Reactor Coolant Pressure Boundary

  "The reactor coolant pressure boundary shall be designed, fabricated, erected and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture."
- Criterion 31 – Fracture Prevention of Reactor Coolant Pressure Boundary

  "The reactor coolant pressure boundary shall be designed with sufficient margin to assure that when stressed under operating, maintenance, testing, and postulated accident conditions (1) the boundary behaves in a non-brittle manner, and (2) the probability of rapidly propagating fracture is minimized. The design shall reflect consideration of service temperatures and other conditions of the boundary material under operating, maintenance, testing and postulated accident conditions and the uncertainties in determining (1) material properties, (2) the effects of

irradiation on material properties, (3) residual, steady state and transient thermal stresses, and (4) size of flaws."

- Criterion 32 – Inspection of Reactor Coolant Pressure Boundary

  "Components which are part of the reactor coolant pressure boundary shall be designed to permit (1) periodic inspection and testing of important areas and features to assess their structural and leak tight integrity, and (2) an appropriate material surveillance program for the reactor pressure vessel."

During the initial plant licensing of Millstone Unit 3, it was demonstrated that the design of the reactor coolant pressure boundary met the regulatory requirements in place at that time. The GDC included in Appendix A to 10 CFR Part 50 became effective May 21, 1971. The construction permit for Millstone Unit 3 was issued after this date, so during initial licensing, Millstone Unit 3 demonstrated that the GDC were met. The following information demonstrates compliance with the design criteria relative to the RPV lower head BMI penetration nozzles:

- Pressurized water reactors licensed both before and after issuance of Appendix A to 10 CFR Part 50 (1971) complied with these criteria in part by: 1) selecting Alloy 600 or other austenitic materials with excellent corrosion resistance and extremely high fracture toughness, for reactor coolant pressure boundary materials, and 2) following ASME Codes and Standards and other applicable requirements for fabrication, erection, and testing of the pressure boundary parts.
- Although stress corrosion cracking of primary coolant system penetrations was not originally anticipated during plant design, it has occurred in the RPV top head nozzles at some plants. The root cause of the boric acid accumulation identified at South Texas Project Unit 1 at two BMI penetration locations has yet to be determined. However, the robustness of the design has been demonstrated by the small amounts of the leakage that have occurred on the RPV upper head penetration nozzles and by the fact that none of the cracks in Alloy 600 reactor coolant pressure boundary materials has rapidly propagated or resulted in catastrophic failure or gross rupture. Given the inherently high fracture toughness and flaw tolerance of the Alloy 600 material, there is in fact an extremely low probability of a rapidly propagating failure and gross rupture. It should be noted that early versions of the applicable GDCs presented design criteria in functional terms of extremely low probability of gross rupture or significant leakage throughout design life.
- The current ASME requirement for the inspection of BMI penetration nozzles is for a visual (VT-2) examination of the bottom of the reactor vessel during the system leakage test of IWB-5221 and/or system pressure test of Code Case N-498-1. Consistent with ASME Code requirement these examinations are performed on the bottom head of the vessel during hot shutdown conditions.

As described above, the requirements established for design, fracture toughness, and inspectability in GDC 14, 31, and 32 respectively were satisfied as applicable during the plant's initial licensing review, and continue to be satisfied during operation. Based on relevant inspections to date, there is no existing plant specific evidence that any of the lower head BMI penetration nozzles at Millstone Unit 3 is cracked or leaking.

Operating Requirement: 10 CFR 50.36 - Plant Technical Specifications

- 10 CFR 50.36 (2) Limiting Conditions for Operation

  "Limiting conditions for operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met. A technical specification limiting condition for operation of a nuclear reactor must be established for each item meeting one of the following criteria:

  Criterion 3: A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

  Criterion 4: A structure, system or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety."

- 10 CFR 50.36 (3) Surveillance Requirements

  "Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions will be met."

The reactor coolant pressure boundary is one of the three physical barriers to the release of radioactivity to the environment. Therefore, Millstone Unit 3 Technical Specifications (TS) include a requirement and associated action statements addressing reactor coolant system leakage. The limits for reactor coolant system leakage at Millstone Unit 3 are one gallon per minute (gpm) for unidentified leakage, ten gpm for identified leakage, and no leakage from the reactor coolant system pressure boundary.

The leakage observed at the two RPV lower head BMI penetration nozzles at South Texas Project Unit 1 were well below the sensitivity of on-line leakage detection systems. Hypothetically, if a through-wall boundary leak of a BMI penetration nozzle increased to the point that the leakage was identified by an on-line leak detection monitor, then the leakage must be evaluated per the specified TS acceptance

criteria. Specifically, the plant would be shut down if the leak exceeded TS limits, or it is determined that the leak is from the reactor coolant system pressure boundary. Plant TS requirements would continue to be met.

Inspection Requirements: 10 CFR 50.55a and ASME Section XI

10 CFR Part 50.55a requires that inservice inspection and testing be performed per the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, "Inservice Inspection of Nuclear Power Plant Components." Currently, the Millstone Unit 3 Code for the inservice inspection program is the 1989 Edition with no Addenda. Section XI contains applicable rules for examination, evaluation and repair of Code class components, including the reactor coolant pressure boundary.

As noted above, the ASME requirement at Millstone Unit 3 for BMI penetration nozzles is for a visual (VT-2) examination of the reactor vessel pressure retaining boundary which includes the BMI penetration nozzles during the system leakage test conducted each refueling outage.

The acceptance standard for the visual examination is found in paragraphs IWA-5250, "Corrective Measures" and IWB-3522, "Standards for Examination Category B-E, Pressure Retaining Partial Penetration Welds in Vessels," and "Examination Category B-P, "All Pressure Retaining Components." For Class 1 components, Paragraph IWA-5250 requires repair or replacement of the affected part if a through-wall leak is found and requires an assessment of damage, if any, associated with corrosion of steel components by boric acid. Should repairs to RPV lower head BMI penetration nozzles be required, they will be performed in accordance with Section XI requirements, NRC-approved ASME Code Case requirements, or an alternative repair or replacement method approved by the NRC.

Millstone Unit 3 complies with these ASME Code requirements through implementation of its inservice inspection program.

Quality Assurance Requirements: 10 CFR 50, Appendix B

- Criterion V of Appendix B to 10 CFR 50

  Criterion V of Appendix B to 10 CFR 50 states that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings. Criterion V further states that instructions, procedures, or drawings shall include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished. Visual examinations of RPV lower head BMI penetration nozzles will be documented in accordance with these requirements. Any of the work undertaken to inspect, evaluate, and/or repair the Millstone Unit 3 RPV lower head BMI penetration nozzles will be conducted and documented

in accordance with existing or new procedures which comply with the Company's Quality Assurance (QA) Topical Report, the QA program, and Criterion V of Appendix B to 10 CFR Part 50.

- Criterion IX of Appendix B to 10 CFR 50

  Criterion IX of Appendix B to 10 CFR 50 states that special processes, including nondestructive testing, shall be controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements.

  Personnel involved with the evaluation of the inspections will be VT-2 qualified in accordance with ASME Code requirements and will be familiar with the anticipated type of indication that leakage would cause. Any repair work that may be required in the event that evidence of leakage is identified at any of the Millstone Unit 3 lower head BMI penetration nozzles will be conducted and documented in accordance with existing or new procedures that will comply with ASME Code, regulatory and Company requirements.

- Criterion XVI of Appendix B to 10 CFR Part 50

  Criterion XVI of Appendix B to 10 CFR Part 50 states that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected. For significant conditions adverse to quality, the measures taken shall include cause determination and corrective action to preclude repetition of the adverse conditions. For potential leakage identified at any RPV lower head BMI penetration nozzle, the cause determination is important to understanding the nature of the degradation present and the required actions to mitigate future cracking. Appropriate corrective actions would be initiated to determine the cause of the leakage and the proper repair technique to be used.

  Criterion XVI contains two important attributes pertinent to the potential for leakage at any RPV lower head BMI penetration nozzle.

  The first of these is "...that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected." This criterion infers a licensee's responsibility to be aware of industry experience, and has been interpreted in this manner in most plants' corrective action programs. A licensee should determine if industry experience applies to its plant and what, if any, corrective actions are appropriate. This approach is consistent with the NRC's generic communication process for an Information Notice, which reports industry experience, but does not require a response to the NRC. Licensees are expected to evaluate the applicability of the occurrence to their plant and document a record of the plant specific assessment for possible NRC review during inspections.

Criterion XVI provides the objectives and goals of the corrective action program, but licensees are responsible for determining a specific process to accomplish these goals and objectives. With regard to the bulletin response, Criterion XVI does not provide specific guidance as to what is an appropriate response, but rather, the licensee is responsible for determining actions necessary to maintain public health and safety. Specifically, in this case, the licensee must justify its actions for addressing the potential of RPV lower head BMI penetration nozzle leakage.

The second attribute of Criterion XVI that should be considered is that for "... significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective action taken to preclude repetition." The bulletin suggests that for potential RPV lower head BMI penetration nozzle leakage, the cause determination is important in understanding the nature of the degradation and the required actions to mitigate future leaks. As part of its corrective action program, a licensee, through its own efforts or as part of an industry effort, would determine the cause of the leakage in an RPV lower head BMI penetration nozzle, if leakage were detected. However, if no known leakage in the BMI penetration nozzles was identified through reasonable quality assurance measures or inspection and monitoring programs, this criterion would not require specific action on the part of a licensee for remaining in compliance with the regulation.

In summary, the integrated industry approach to inspection, monitoring, cause determination, and resolution of potential leakage of an RPV lower head BMI penetration nozzle is clearly in compliance with the performance-based objectives of Appendix B. Therefore, DNC continues to believe that the appropriate regulatory requirements have been met to date.

(b) A description of the RPV lower head penetration inspection program that will be implemented at your plant during the next and subsequent refueling outages. The description should include the extent of the inspections which will be conducted with respect to the areas and penetrations to be inspected, inspection methods to be used, qualification standards for the inspection methods, the process used to resolve the source of findings of boric acid deposits or corrosion, the inspection documentation to be generated, and the basis for concluding that your plant will satisfy applicable regulatory requirements related to the structural and leakage integrity of the RPV lower head penetrations.

Response

A 360-degree bare-metal VT-2 visual examination of the fifty-eight (58) BMI penetration nozzles will be performed during the next Millstone Unit 3 refueling outage currently scheduled for the of Spring 2004. Personnel performing this procedure will be qualified as ASME visual level 2 (VT-2) examiners or greater. Each BMI penetration nozzle will be examined for the full 360-degree circumference. Inspection results will be recorded in an inspection report and maintained in station records. High-resolution video recording equipment and/or high-resolution digital still photographs may also be employed to further document the examination, as appropriate.

Millstone will document the as-found condition of suspect deposits on the RPV lower head. Any such deposit will be carefully evaluated to determine the most likely origin of the material based on visual, physical, and chemical evidence, as appropriate. Visual evidence will be evaluated with consideration of the guidance and examples given in industry reference materials for similar inspections of RPV upper heads supplemented by the recent observed conditions at South Texas Project. Relevant physical evidence will be collected in a methodical manner that is intended to provide reliable, documented data for use in the evaluation process. Chemical and radioisotopic analysis techniques may be employed where appropriate to help discriminate between indications with operational implications versus indications from outage-related sources. Should evidence of boric acid deposits be identified on any of the BMI penetration nozzles, the finding will be entered into the corrective action program for tracking, cause determination and disposition/resolution of the condition. Appropriate notifications would be made consistent with regulatory requirements.

It is intended that a 360-degree bare-metal visual examination of each RPV lower head BMI penetration nozzle will be performed during each subsequent refueling outage. This schedule may be adjusted in the future should ongoing research and inspection results determine that a less frequent (e.g., performance-based) inspection or sampling schedule is warranted.

Adherence to regulatory requirements was discussed in the response to Item 1(a) above. The performance of the full 360-degree bare-metal visual examination of the RPV lower head BMI penetration nozzles during each subsequent refueling will further assure adherence to regulatory requirements.

(c) If you are unable to perform a bare-metal visual inspection of each penetration during the next refueling outage because of the inability to perform the necessary planning, engineering, procurement of materials, and implementation, are you planning to perform bare-metal visual inspections during subsequent refueling outages? If so, provide a description of the actions that are planned to enable a bare-metal visual inspection of each penetration during subsequent refueling outages. Also, provide a description of any penetration inspections you plan to perform during the next refueling outage. The description should address the applicable items in paragraph (b).

Response

A full 360-degree bare-metal visual examination of the fifty-eight (58) BMI penetration nozzles is planned during the next Millstone Unit 3 refueling outage currently scheduled for the Spring of 2004. Although not expected based on previous inspection results, if boric acid from other sources is present, it could potentially mask leakage conditions at the nozzles should they exist. In that case, the masking boric acid and/or debris will be cleaned off the nozzles to allow a full assessment of the affected penetrations during the ongoing outage, if possible.

(d) If you do not plan to perform either a bare-metal visual inspection or non-visual (e.g., volumetric or surface) examination of the RPV lower head penetrations at the next or subsequent refueling outages, provide the basis for concluding that the inspections performed will assure applicable regulatory requirements are and will continue to be met.

Response

Millstone Unit 3 is planning to perform 360-degree bare-metal visual VT-2 examinations of the fifty-eight (58) BMI penetration nozzles underneath the RPV lower head insulation during: 1) the next Millstone Unit 3 refueling outage currently scheduled for the Spring 2004 and, 2) each subsequent refueling outage. However, this schedule may be adjusted in the future should ongoing research and inspection results determine that a less frequent (e.g., performance-based) inspection or sampling schedule is warranted.